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A FLORISTIC SURVEY OF FALLS HOLLOW SANDSTONE GLADES, PULASKI COUNTY, MISSOURI

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ABSTRACT

The vascular flora of Falls Hollow sandstone glades, Pulaski County, Missouri, is reported. A total of 137 species is listed. Twenty-three new taxa are added to the known vascular flora of Pulaski County. Three species collected during this study are on the Missouri Department of Conservation's list of Rare and Endangered Species.

KEY WORDS: Sandstone glade, flora, Missouri

INTRODUCTION

Missouri glades are open expanses of bare rock in non-prairie areas characterized by a herbaceous flora, a lack or scattered occurrence of woody plants, and droughty soils that are often seasonally saturated. The original objective of this study was to survey the vascular flora of three sandstone glades at Falls Hollow on Fort Leonard Wood Army Base, Pulaski County, Missouri, to determine their suitability for nomination as a natural area by the Missouri Department of Conservation. These three glades were located by Skinner (1991), and I located a fourth glade during the present study. The purpose of this paper is to present the results of a floristic survey of these previously unbotanized sandstone glades in Missouri.

DESCRIPTION OF STUDY AREA

Falls Hollow glades are located approximately 17.7 km south-southeast of St. Roberts, Pulaski County, Missouri, on Fort Leonard Wood Military Installation (Bloodland Quadrangle, T34N, R11W, Sec. 22 NW1/4). Pulaski County lies within the Upper Ozark Section of the Ozark Natural Division (Thom & Wilson 1980). Falls Hollow consists of four glades totaling 2.0 ha. The largest of these glades is 0.8 ha., whereas the three smaller glades are approximately 0.4 ha each. The aspect of the glades at Falls Hollow is neutral and the slope is mostly flat to gentle. Each glade is separated from the others by dry to mesic sandstone forest dominated by *Quercus* spp. In the case of the three smaller glades a narrow ecotone exists between the forest and

the glades, with *Vaccinium arboreum* Marshall and *Quercus marilandica* Muenchh. most common in this zone. The substrate of the glades at Falls Hollow is Roubidoux sandstone (Ryan 1992; Wolf 1989), a medium to fine-grained, sparsely fossiliferous sandstone that originated during the Ordovician Period (Koenig 1961). Although sandstone occurs widely in the Missouri Ozarks, exposed areas of sandstone bedrock in non-prairie regions large enough to warrant the name glade are now uncommon (Nelson 1987); this is particularly so with sandstone glades of the Roubidoux formation. Known glades on this formation are rare (< 10 ha) and restricted to four counties in south-central Missouri (Nelson 1987; Currier 1991; Ryan 1992; Ryan & Smith 1991).

The glades at Falls Hollow are particularly interesting in that they are exclusively associated with intermittent streams. During heavy rains, which are frequent in the spring, these streams flood the glades. The impact of such flooding is evident in the obvious patterns of erosion present (Figure 1). Frequent flooding has been a significant factor in keeping these glades open, whereas fire has probably played a secondary role in maintaining these sites historically. Although flooding has kept substantial areas of bedrock open and largely free of vegetation, it has also created habitats suitable for certain plants. Because sections of the sandstone are more resistant to erosion and weathering (Beveridge 1990), the glades have developed ledges, depressions, and other structures where water pools and soil accumulates. These processes have added floristic richness to the glades by creating areas where plant species not ordinarily associated with glades, such as *Alopecurus carolinianus* Walter, *Cyperus acuminatus* Torrey & Hook., *Gratiola neglecta* Torrey, *Leersia oryzoides* (L.) Swartz, *Lythrum alatum* Pursh, and *Rotala ramosior* (L.) Koehne, can thrive.

There is no evidence of prior botanical work at Falls Hollow. Prior to 1940 this area was utilized for farming and grazing, and in 1940 the land was purchased by the Department of the Army for the construction of Fort Leonard Wood. Given the small size of each glade and their location on a military reservation, it is likely that previous workers either overlooked or were unable to access these glades (Steyermark 1963; Johnson *et al.* 1990). Skinner (1991) located the glades at Falls Hollow and Ryan (1992) assessed them as part of a natural features inventory, but neither botanized the site intensively.

METHODS

Forty-one trips were made to Falls Hollow on a weekly basis from 1 April to 23 October 1994, and all glades were surveyed during each visit; during late spring and early fall, the glades were often visited twice weekly. Vouchers were deposited at UMO, with the exception of specimens representing county records and rare and endangered species, which were deposited at MO. Verification of county records and difficult taxa was made by Dr. George Yatskievych of the Missouri Department of Conservation. Grasses were verified by Dr. Michel Lelong of the University of South Alabama, and Dr. Robert Kral of Vanderbilt University verified the sedges.

Determinations were made principally using Steyermark (1963). Plants were occasionally identified with Gleason & Cronquist (1991). Identification of *Aster* spp. was made with Jones (1989). Nomenclature follows Yatskievych & Turner (1990), with the exception of *Panicum*, which follows Lelong (1986), and *Heuchera* × *hirsuticaulis* (Wheelock) Rydb. which follows Gleason & Cronquist (1991).

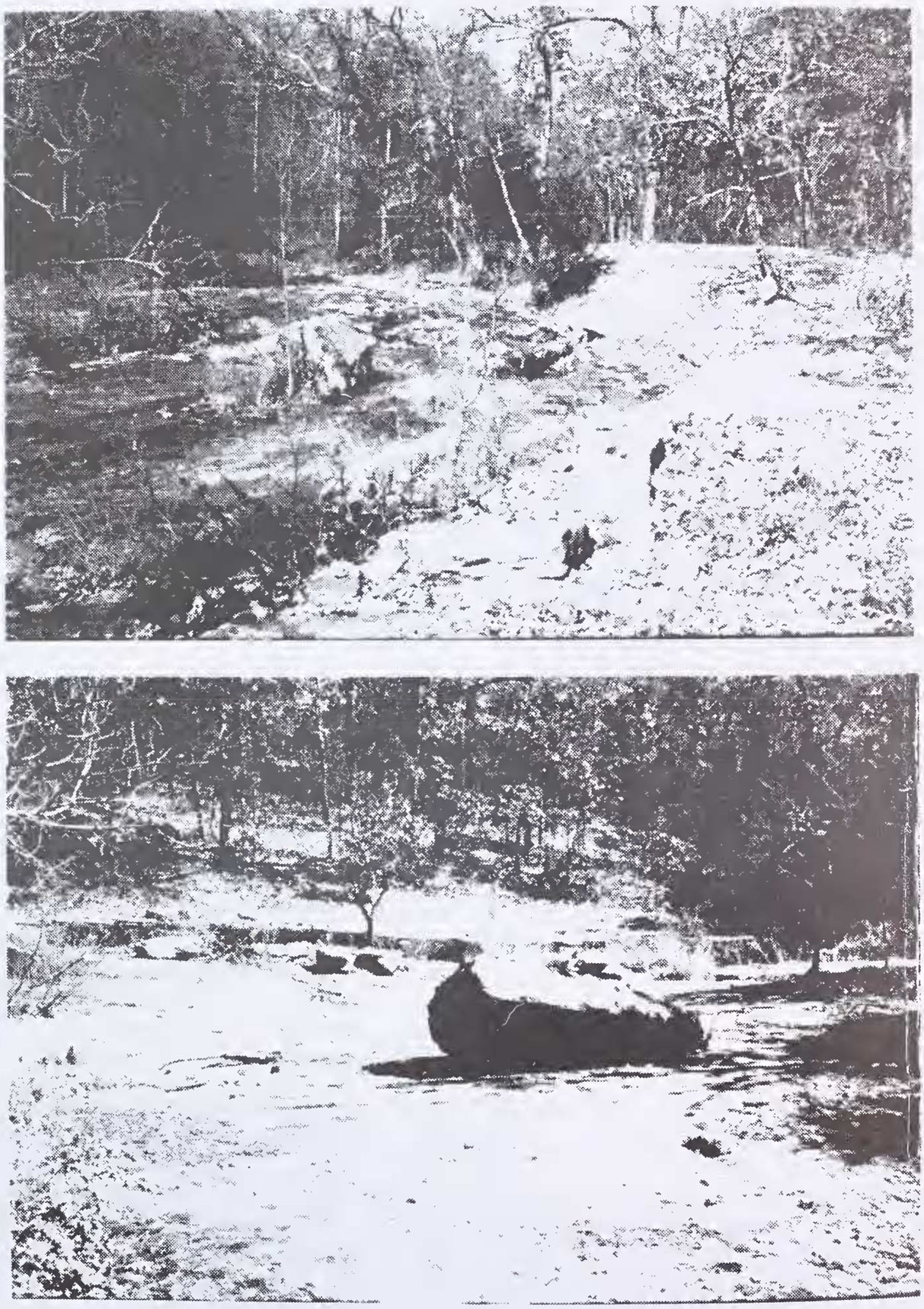

Figure 1. Glade at Falls Hollow, as seen from south (top photo), and west (bottom photo). Top photo shows course of intermittent stream; arrow indicates the point where the stream enters the glade.

RESULTS/DISCUSSION

Only the flora of the three smaller glades is reported here. My decision to exclude the largest (0.8 ha) glade is based upon the severe impact that has occurred due to the construction of a military firing range adjacent to the glade. Large amounts of soil (in the form of numerous dirt mounds), gravel, and other debris (expended rifle shells, glass and metal containers and plastic items) were deposited on the glade during the construction of the range; frequent maintenance of the range has produced a constant supply of fresh debris. It is, in fact, often hard to determine which parts of the glade are natural and which ones are the result of intense human activity. By comparison, the three smaller glades show no signs of recent disturbance and are comparable to other Roubidoux sandstone glades judged to be high quality communities (Ryan 1992). It was felt that the inclusion of the largest glade, with its large number of non-native and weedy taxa, would misrepresent the true nature of the Falls Hollow glade community.

Due to the rarity of sandstone glades in Missouri, I would encourage those involved with land management at Fort Leonard Wood to conserve Falls Hollow glades. The greatest potential for conservation lies with the three smaller, high quality glades. These glades are not directly impacted by the firing range, as is the largest glade, and management efforts would be minimal. In fact, as long as there is no human disturbance in the form of logging, construction, or vehicular traffic, these three glades would require only slight management in the form of a prescribed burn plan. Although they are maintained principally by flooding, rather than by fire, a fire management plan would nonetheless be beneficial. By reducing woody invasion along the borders of the glades - the areas least affected by flooding - fire would diversify the habitat around the glades by maintaining or expanding (or in some cases creating) the ecotone between the forest and each glade.

A total of 137 taxa, representing 48 families and 104 genera, was collected. A list of the plant taxa collected at Falls Hollow glades follows. Poaceae (26) and Asteraceae (13) are the two families with the largest number of representatives. Three species identified during this study, *Silene regia* Sims, *Sporobolus ozarkanus* Fernald, and *Trifolium reflexum* L. var. *reflexum*, are currently on the Missouri Department of Conservation's list of Rare and Endangered Species (1992). Due to the rarity of *Silene regia* at Falls Hollow, a photo voucher was made in lieu of an actual collection.

Plants characteristic of Falls Hollow glades include *Crotonopsis elliptica* Willd., *Diodia teres* Walter, *Hypericum gentianoides* (L.) Britton, *Juniperus virginiana* L., *Schizachyrium scoparium* (Michaux) Nash, *Sporobolus* spp., *Vaccinium arboreum*, and *Vulpia octoflora* (Walter) Rydb. Each of these species, with the exception of *Juniperus virginiana* and *Sporobolus* spp., is listed as characteristic of sandstone glades in Missouri by Nelson & Ladd (1983). Studies indicate that the species composition of sandstone glades vary, however, based upon the age and origin of the substrate, slope and aspect, and recent vegetational history. Based on the list of taxa reported from previous work, only *Quercus marilandica*, *Schizachyrium scoparium*, and *Vaccinium arboreum* are known to occur on all sandstone glades (Bacone *et al.* 1983; Jefferies 1985, 1987; MacRoberts & MacRoberts 1992, 1993). The literature also indicates that dominants vary. Bacone *et al.* (1983), Jefferies (1987), and MacRoberts & MacRoberts (1992, 1993), list *Schizachyrium scoparium* as the dominant or co-dominant plant species on sandstone glades. Jefferies (1985) found *Coreopsis grandiflora* (Hogg) *ex* Sweet and *Crotonopsis elliptica* to be dominant on calico sandstone in northern Arkansas. At Falls Hollow, *Schizachyrium scoparium* and *Sporobolus* spp. were apparently co-dominants at one glade, whereas *Sporobolus*

spp. and *Aristida* spp. were apparently co-dominants on the other two glades. This is interesting, because glades where *Sporobolus* spp. were previously noted as dominant or abundant had substrates other than sandstone (Quarterman 1950; Kucera & Martin 1957; Baskin & Baskin 1973, 1977, 1978; Nelson 1987). But as MacRoberts & MacRoberts (1993) and Jefferies (1985) have noted, sandstone glades are less studied than glades of other substrates. Future studies should reveal more about the similarities and differences among sandstone glades.

Scientific names of new taxa for Pulaski County are preceded by an asterisk. Within each group, families, genera, and species are arranged alphabetically.

PTERIDOPHYTA

Adiantaceae

Cheilanthes lanosa (Michaux) D. Eaton

Aspleniaceae

Asplenium platyneuron (L.) Britton, Sterns, & Pogg. var. *platyneuron*

Dryopteridaceae

**Cystopteris tennesseensis* Shaver
Dryopteris marginalis (L.) A. Gray

PINOPHYTA

Cupressaceae

Juniperus virginiana L. var. *virginiana*

MAGNOLIOPHYTA

MAGNOLIOPSIDA

Acanthaceae

Ruellia humilis Nutt.

Anacardiaceae

Rhus copallina L.
R. glabra L.

Asteraceae

Ambrosia artemisiifolia L.
Ambrosia bidentata Michaux
Antennaria plantaginifolia (L.) Hook.
Aster linariifolius L. var. *linariifolius* forma *linariifolius*
Aster pilosus Willd.
Aster sericeus Vent. forma *sericeus*
**Heliopsis helianthoides* (L.) Sweet var. *occidentalis* (T. Fisher) Steyerm.
Hieracium gronovii L.
Krigia dandelion (L.) Nutt.
K. virginica (L.) Willd.
Rudbeckia missouriensis Pursh
Solidago nemoralis Dryander
S. ulmifolia Muhlenb. *ex* Willd.

Brassicaceae

Cardamine concatenata (Michaux) O. Schwarz
C. parviflora L. var. *arenicola* (Britton) O. Schwarz
Draba brachycarpa Nutt. *ex* Torrey & A. Gray

Cactaceae

**Opuntia humifusa* (Raf.) Raf. var. *humifusa*

Caesalpinaceae

Cercis canadensis L.

Callitrichaceae

Callitriche heterophylla Pursh var. *heterophylla*

Caprifoliaceae

Lonicera flava Sims
Symphoricarpos orbiculatus Moench
Viburnum rufidulum Raf.

Caryophyllaceae

Arenaria serpyllifolia L.
Cerastium brachypetalum Pers.
**Paronychia fastigiata* (Raf.) Fernald var. *paleacea* Fernald
Silene regia Sims

Clusiaceae

Hypericum gentianoides (L.) Britton
H. punctatum Lam.

Cornaceae

Cornus florida L.

Ebenaceae

**Diospyros virginiana* L. var. *platycarpa* Sarg. forma *platycarpa*

Ericaceae

Vaccinium arboreum Marshall

Euphorbiaceae

Croton capitatus Michaux var. *capitatus*
Crotonopsis elliptica Willd.
Euphorbia corollata L.
Tragia betonicifolia Nutt.

Fabaceae

Baptisia alba (L.) Vent.
Stylosanthes biflora (L.) Britton, Stearns, & Pogg
Tephrosia virginiana (L.) Pers.
Trifolium reflexum L. var. *reflexum*

Fagaceae

Quercus alba L.
Q. marilandica Muenchh.
Q. stellata Wangenh. var. *stellata*

Juglandaceae

Carya texana Buckley

Linaceae

Linum medium (Planchon) Britton var. *texanum*

Lythraceae

Cuphea viscosissima Jacq.
Lythrum alatum Pursh var. *alatum*
Rotala ramosior (L.) Koehne

Mimosaceae

Schrankia nuttallii (DC. *ex* Britton & Rose) Standley

Oleaceae

Fraxinus americana L.

Onagraceae

Ludwigia alternifolia L.
Oenothera linifolia Nutt.

Oxalidaceae

Oxalis violacea L.

Plantaginaceae

Plantago aristata Michaux
P. pusilla Nutt. var. *pusilla*
P. virginica L.

Polemoniaceae

**Phlox pilosa* L. subsp. *ozarkana* (Wherry) Wherry

Polygalaceae

Polygala sanguinea L. forma *sanguinea*

Polygonaceae

Polygonum tenue Michaux
Rumex acetosella L.

Portulacaceae

Portulaca oleracea L.
Talinum calycinum Engelm.

Ranunculaceae

Ranunculus fascicularis Muhlenb. *ex* Bigelow
R. harveyi (A. Gray) Britton forma *harveyi*

Rhamnaceae

Rhamnus caroliniana Walter

Rosaceae

**Prunus hortulana* L.
P. mexicana S. Wats.
Rosa carolina L.
Rosa setigera Michaux var. *setigera* forma *setigera*
Rosa setigera Michaux var. *tomentosa* Torrey
Rubus flagellaris Willd.
**Rubus invisus* (L. Bailey) Britton

Rubiaceae

Cephalanthus occidentalis L.
Diodia teres Walter
Hedyotis crassifolia Raf.

Sapotaceae

Bumelia lanuginosa (Michaux) Pers.

Saxifragaceae

Heuchera × *hirsuticaulis* (Wheelock) Rydb.

Scrophulariaceae

Agalinis tenuifolia (M. Vahl) Raf.
**Gratiola neglecta* Torrey
Leucospora multifida (Michaux) Nutt.
**Nuttallanthus canadensis* (L.) D. Sutton
Penstemon pallidus Small

Ulmaceae

Celtis tenuifolia Nutt. var. *tenuifolia*
Ulmus rubra Muhlenb.

Violaceae

Viola pedata L. forma *pedata*
V. rafinesquii Greene

LILIOPSIDA

Commelinaceae

Tradescantia ohiensis Raf.

Cyperaceae

**Bulbostylis capillaris* (L.) C.B. Clarke
Carex bushii Mackenzie
Carex flaccosperma Dewey var. *glaucodea* (Tuckerman) Kük.
Cyperus acuminatus Torrey & Hook.
Cyperus aristatus Rottb.
Fimbristylis autumnalis (L.) Roemer & Schultes
Lipocarpha micrantha (M. Vahl) G. Tucker
**Rhynchospora globularis* (Chapman) Small var. *recognita* Gale

Iridaceae

Sisyrinchium campestre E. Bickn. forma *campestre*

Juncaceae

Luzula bulbosa (Alph. Wood) Rydb.
Juncus interior Wieg.

Liliaceae

Allium canadense L. var. *canadense*
Allium canadense L. var. *mobilense* (Regal) F. Ownbey
Camassia scilloides (Raf.) Cory forma *scilloides*
Hypoxis hirsuta (L.) Cov. forma *vilosissima*
Nothoscordum bivalve (L.) Britton

Orchidaceae

**Spiranthes tuberosa* Raf.

Poaceae

Agrostis elliottiana Schultes
Agrostis hyemalis (Walter) Britton, Sterns, & Pogg var. *hyemalis*
Agrostis perennans (Walter) Tuckerman
**Alopecurus carolinianus* Walter
Andropogon gerardii Vitman var. *gerardii*
Aristida dichotoma Michaux var. *dichotoma*
**Aristida longespica* Poiret var. *longespica*
**Aristida purpurascens* Poiret
Danthonia spicata (L.) P. Beauv. *ex* Roemer & Schultes var. *spicata*
**Digitaria cognata* (Schultes) Pilger var. *cognata*
**Leersia oryzoides* (L.) Swartz
L. virginica Willd.
**Muhlenbergia mexicana* (L.) Trin.
Panicum acuminatum Swartz var. *acuminatum*
P. depauperatum Muhlenb.
P. flexile (Gattinger) Scribner
**P. philadelphicum* Trin. var. *philadelphicum*
P. virgatum L.
Schizachyrium scoparium (Michaux) Nash
Sphenopholis obtusata (Michaux) Scribner var. *obtusata*
**Sporobolus asper* (Michaux) Kunth var. *asper*
Sporobolus clandestinus (Biehler) A. Hitchc.
**Sporobolus ozarkanus* Fernald
**Sporobolus vaginiflorus* (Torrey) Alph. Wood
Tridens flavus (L.) A. Hitchc. var. *flavus*
Vulpia octoflora (Walter) Rydb. var. *glauca* (Nutt.) Fernald

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